EFFECT OF DIFFERENT LEVELS OF COMPACTION ON RICE GRAIN YIELD

M. Javid*, M. Asghar Rana, A.D. Chaudhry, Qamar-uz-Zaman & M. Saleem*
Faculty of Agricultural Engineering & Technology,
**Directorate of Crop Production & Water Management,*
University of Agriculture, Faisalabad

Field experiments were conducted to study different compaction levels on rice growth. Surface compaction treatments were given at two levels of dry bulk density with the help of steel roller. It was observed that the rice yield was significantly higher at 1.65 Mg m^{-3} compaction level, compared to the control. However, water use efficiency and cost benefit ratio of surface compaction were increased considerably compared to puddled field as the yield was 19% higher at 1.65 Mg m^{-3} surface compaction than that from the puddled field.

INTRODUCTION

Rice is grown in puddled fields. Puddling reduces the soil infiltration but creates hindrances to the regeneration of soil structure and impedes root growth. However, puddling is laborious, time consuming and difficult field operation. In country like Pakistan where water is already short, development of alternate method which consumes relatively less water for growing rice is imperative so that the available water supplies are used effectively. The reduction of water infiltration can also be achieved by surface compaction through increased dry bulk density.

Ghildyal (1978) reported that the soil compaction up to densities of 1.75 Mg m^{-3} reduced the water requirement of rice crop considerably as compared with puddling, while the yield increased. Tanaka and Yoshida (1970) noted that puddling and subsequent continuous submergence caused several nutritional disorders such as phosphorus, potassium, zinc deficiencies, iron toxicity, etc. in tropical Asia. The formation of relatively impermeable layers or plow pans is attributed to physical compaction at same depth during puddling (Moormann and Dudal, 1964). Compaction of the soil with a roller has been suggested by Varade and Ghildyal (1967) as the yield of rice grain, total dry matter and roots were positively correlated with soil bulk densities.

Varade and Patil (1971) reported that compaction increased rice grain yield over with puddling despite restricted root growth in compacted soil layers. Gupta and Kathawate (1974) observed the highest grain yield of NP-130 and IR-8 rice varieties at compaction levels of 1.82 and 1.72 g cm^{-3}.

METHODOLOGY

Experiment was performed at Shahkot Project Area of Water Management Research Project, University of Agriculture, Faisalabad. Total nine plots of 6 m x 64 m size were used for the comparison of puddled field with two levels of soil surface compaction. Two compaction levels of 1.25 and 1.65 Mg m^{-3} dry soil bulk density were achieved by various passes of steel roller drawn by tractor. Each test was replicated thrice and CRD design was used.

For puddling, fields were plowed fol-

lowed by planking and served as controls. The compaction treatments were given at "wattar" conditions. Basmatti-385 seedlings of 30 days age were planted manually in rows at plant to plant spacing of 30 cm. A total of 115 kg nitrogen and 65 kg P_2O_5 per hectare were applied to meet the fertilizer requirement and 14 irrigations, each of 7 cm depth were applied. The irrigation interval was 7 days for each treatment.

nal grain yield were made to find the effect of different rice planting techniques.

RESULTS AND DISCUSSION

Effect of compaction on water use efficiency and grain yield: The yield at surface compaction of 1.65 Mg m^{-3} was higher significantly compared to that from control

Table 1. Effect of compaction treatments on grain yield and water use efficiency

Treatment	Grain yield (Ton ha^{-1})	Water use (cm) irrigation + rain	Water use efficiency kg rice/ cm of water used ha^{-1}
Puddling	3.45	127*	27
1.25 Mg m^{-3} BD	3.41	115	30
1.65 Mg m^{-3} BD	4.10	115	36

*12 cm depth of irrigation water used for puddling.

Table 2. Comparison of cost benefits of rice crop due to compaction treatments

Operation	Puddling cost (Rs ha^{-1})	Compaction cost (Rs ha^{-1})	
		1.25 Mg m^{-3}	1.65 Mg m^{-3}
Rent/ha/crop	1200	1200	1200
Land preparation	600	600	600
Water for puddling	118	-	-
Puddling/Compaction	500	130	260
Agronomic practices	2523	2523	2523
Total cost Rs ha^{-1}	5951	5463	5593
Yield Rs ha^{-1}	12938	12788	15375
Net income	6987	7325	9782
Cost benefit ratio	1:1.17	1:1.34	1:1.75

One weeding operation after 30 days from transplanting was carried out manually. Physical observations on water used and fi-

(puddled) plots. While the yield at surface compaction of 1.25 Mg m^{-3} was negligibly less compared to that from the control

(puddled field). Soil compaction of 1.65 Mg m^{-3} reduced the water requirement of crop and gave higher water use efficiency compared with puddling and low level of surface compaction (Table 1).

The increased water use efficiency after compaction may be was due to reduced percolation losses because compaction destroys the soil macro voids and results in decreased hydraulic conductivity and hence percolation losses as well.

Economic analysis: Puddling operation cost was more by 137% than that to high level compaction operation (Table 2). Where the overall difference in total cost was only 6% high in case of puddling. However, the net income was 40% higher in 1.65 Mg m^{-3} surface compaction method than that from the puddling method. The cost benefit ratios were 1:1.17 and 1:1.75 for puddling and surface compaction, respectively. It suggests that the surface compaction techniques for rice planting is beneficial in terms of net return.

REFERENCES

Ghildyal, B.P. 1978. Soils and Rice. Int. Rice Res. Inst. Los Banos, Philippines. pp: 317-330.

Gupta, J.D. and Y.V. Kathawate. 1974. Soils and Rice. Int. Rice Res. Inst. Los Banos, Philippines. pp: 333.

Moorman, F.R. and R. Dudal. 1964. Characteristics of soil on which paddy is grown in relation to their capability classification. Int. Rice Commission Working Party on Rice, Soils, Water and Fertilizer Practices. Manila, Philippines. pp: 18.

Tanaka, A. and S. Yoshida. 1970. Nutritional disorder of rice plant in Asia. Int. Rice Res. Inst. Tech. Bull 10. pp: 51.

Varade, S.B. and B.P. Ghildyal. 1967. Principles and Practices of Rice Production. McGraw Hill Book Co. Inc., New York, Toronto, London. pp. 286.

Varade, S.B. and E.A. Patil. 1971. Principles and Practices of Rice Production. McGraw Hill Book Co. Inc., New York, Toronto, London. pp: 288.